2.2.6 Chemical and Volume Control System

1.0 Description

The chemical and volume control system (CVCS) is a non-safety-related system that provides some safety related functions. The CVCS provides the following safety-related functions:

- Boron dilution mitigation.
- Reactor coolant pressure boundary integrity.
- Containment isolation.
- Charging flow isolation.

The CVCS provides the following non-safety-related functions:

- Pressurizer auxiliary spray.
- Reactor coolant pump seal water.
- Reactor coolant chemistry control.

2.0 Arrangement

2.1 The functional arrangement of the CVCS is as shown on Figure 2.2.6-1—Chemical and Volume Control System Functional Arrangement.

2.2 The location of the CVCS equipment is as listed in Table 2.2.6-1—CVCS Equipment Mechanical Design.

3.0 Mechanical Design Features

3.1 Deleted.

3.2 Check valves listed in Table 2.2.6-1 will function as listed in Table 2.2.6-1.

3.3 Deleted.

3.4 Components identified as Seismic Category I in Table 2.2.6-1 can withstand seismic design basis loads without a loss of the function listed in Table 2.2.6-1.

3.5 Deleted.

3.6 Deleted.

3.7 Deleted.

3.8 Deleted.

3.9 Deleted.

3.10 CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 is designed in accordance with ASME Code Section III requirements.

3.11 CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 is installed in accordance with an ASME Code Section III Design Report.

3.12 Pressure boundary welds in CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 are in accordance with ASME Code Section III.

3.13 CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 retains pressure boundary integrity at design pressure.

3.14 CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 is installed and inspected in accordance with ASME Code Section III requirements.

3.15 Components listed in Table 2.2.6-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

3.16 Components listed in Table 2.2.6-1 as ASME Code Section III are fabricated in accordance with ASME Code Section III requirements.

3.17 Pressure boundary welds on components listed in Table 2.2.6-1 as ASME Code Section III are in accordance with ASME Code Section III requirements.

3.18 Components listed in Table 2.2.6-1 as ASME Code Section III retain pressure boundary integrity at design pressure.

4.0 Instrumentation and Controls (I&C) Design Features, Displays, and Controls

4.1 Displays listed in Table 2.2.6-2—CVCS Equipment I&C and Electrical Design are retrievable in the main control room (MCR) and the remote shutdown station (RSS) as listed in Table 2.2.6-2.

4.2 The CVCS equipment controls are provided in the MCR and the RSS as listed in Table 2.2.6-2.

4.3 Equipment listed as being controlled by a priority and actuator control system (PACS) module in Table 2.2.6-2 responds to the state requested by a test signal.

4.4 The CVCS has the following system interlocks:

- Isolation of the charging pump suction from the volume control tank and normal letdown path during a boron dilution event by closure of valves 30KBA21AA001, 30KBA21AA009, and 30KBA25AA017.
- Isolation of the charging line by closure of valves 30KBA34AA002, 30KBA34AA012, and 30KBA35AA001.

- Isolation of the letdown line on a safety injection actuation signal by closure of valves 30KBA10AA001 and 30KBA10AA002.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.2.6-2 are powered from the Class 1E division as listed in Table 2.2.6-2 in a normal or alternate feed condition.

5.2 Valves listed in Table 2.2.6-2 fail as-is on loss of power.

6.0 Environmental Qualifications

6.1 Components in Table 2.2.6-2, that are designated as harsh environment, will perform the function listed in Table 2.2.6-1 in the environments that exist during and following design basis events..

7.0 Equipment and System Performance

7.1 Deleted.

7.2 Class 1E valves listed in Table 2.2.6-2 can perform the function listed in Table 2.2.6-1 under system operating conditions.

7.3 Containment isolation valves listed in Table 2.2.6-1 close within the containment isolation response time following initiation of a containment isolation signal.

7.4 The system run-out flow does not exceed the design maximum allowable.

7.5 The CVCS charging pumps listed in Table 2.2.6-1 provide the required seal water flow for operation of the reactor coolant pumps.

8.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.2.6-3 lists the CVCS ITAAC.

Table 2.2.6-1—CVCS Equipment Mechanical Design (3 Sheets)

Description	Tag Number[(1)]	Location	ASME Code Section III	Function	Seismic Category
RC Pressure Boundary Valve	30KBA10AA001	Reactor Building	yes	close	I
RC Pressure Boundary Valve	30KBA10AA002	Reactor Building	yes	close	I
Regenerative Heat Exchanger	30KBA10AC001	Reactor Building	yes	RCPB	I
#1 HP Cooler	30KBA11AC001	Reactor Building	yes	RCPB	I
#2 HP Cooler	30KBA12AC001	Reactor Building	yes	RCPB	I
Isolation valve to KTA	30KBA14AA009	Reactor Building	yes	close	I
Isolation valve to KTA	30KBA14AA011	Reactor Building	yes	close	I
Containment Isolation Valve	30KBA14AA002	Reactor Building	yes	close	I
Containment Isolation Valve	30KBA14AA003	Fuel Building	yes	close	I
Volume Control Tank	30KBA20BB001	Fuel Building	N/A	storage volume	N/A
Boron Dilution Valve	30KBA25AA017	Fuel Building	yes	close	I
Boron Dilution Valve	30KBA21AA001	Fuel Building	yes	close	I
Boron Dilution Valve	30KBA21AA009	Fuel Building	yes	close	I
#1 Charging Pump	30KBA31AP001	Fuel Building	N/A	run	N/A
#2 Charging Pump	30KBA32AP001	Fuel Building	N/A	run	N/A
Charging Line Containment Isolation Valve	30KBA34AA002	Fuel Building	yes	close	I

Table 2.2.6-1—CVCS Equipment Mechanical Design (3 Sheets)

Description	Tag Number[(1)]	Location	ASME Code Section III	Function	Seismic Category
Charging Line Containment Isolation Check Valve	30KBA34AA003	Reactor Building	yes	close	I
Pressurizer Spray Isolation Valve	30KBA35AA001	Reactor Building	yes	close	I
Pressurizer Spray Check Valve	30KBA35AA002	Reactor Building	yes	close	I
Charging Line Isolation Valve	30KBA34AA012	Reactor Building	yes	close	I
RC Pressure Boundary Check Valve	30KBA34AA018	Reactor Building	yes	close	I
RC Pressure Boundary Check Valve	30KBA34AA019	Reactor Building	yes	close	I
RC Pressure Boundary Check Valve	30KBA34AA020	Reactor Building	yes	close	I
RC Pressure Boundary Check Valve	30KBA34AA021	Reactor Building	yes	close	I
Seal Injection Containment Isolation Valve	30JEW01AA005	Fuel Building	yes	close	I
Seal Injection Containment Isolation Check Valve	30JEW01AA006	Reactor Building	yes	close	I
#1 RCP Seal Injection Flow Control Valve	30JEW11AA111	Reactor building	yes	open	I
#2 RCP Seal Injection Flow Control Valve	30JEW21AA111	Reactor Building	yes	open	I

Table 2.2.6-1—CVCS Equipment Mechanical Design (3 Sheets)

Description	Tag Number(1)	Location	ASME Code Section III	Function	Seismic Category
#3 RCP Seal Injection Flow Control Valve	30JEW31AA111	Reactor Building	yes	open	I
#4 RCP Seal Injection Flow Control Valve	30JEW41AA111	Reactor Building	yes	open	I
RCP Seal Leak-off to KTA	30JEW50AA021	Reactor Building	yes	open, close	I
RCP Seal Leak-off Containment Isolation Valve	30JEW50AA001	Reactor Building	yes	close	I
RCP Seal Leak-off Containment Isolation Valve	30JEW50AA002	Fuel Building	yes	close	I

1) Equipment tag numbers are provided for information only and are not part of the certified design.

Table 2.2.6-2—CVCS Equipment I&C and Electrical Design (2 Sheets)

Description	Tag Number (1)	Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
RC Pressure Boundary Valve	30KBA10AA001	Reactor Building	1^N 2^A	yes	yes	Position / N/A	Open-Close / N/A
RC Pressure Boundary Valve	30KBA10AA002	Reactor Building	4^N 3^A	yes	yes	Position / N/A	Open-Close / N/A
Containment Isolation Valve	30KBA14AA002	Reactor Building	1^N 2^A	yes	yes	Position / N/A	Open-Close / N/A
Containment Isolation Valve	30KBA14AA003	Fuel Building	4^N 3^A	N/A	yes	Position / N/A	Open-Close / N/A
Boron Dilution Valve	30KBA25AA017	Fuel Building	4^N 3^A	N/A	yes	Position / N/A	Open-Close / N/A
Boron Dilution Valve	30KBA21AA001	Fuel Building	4^N 3^A	N/A	yes	Position / N/A	Open-Close / N/A
Boron Dilution Valve	30KBA21AA009	Fuel Building	1^N 2^A	N/A	yes	Position / N/A	Open-Close / N/A
#1 Charging Pump	30KBA31AP001	Fuel Building	N/A	N/A	N/A	On-Off / N/A	Start-Stop / N/A
#2 Charging Pump	30KBA32AP001	Fuel Building	N/A	N/A	N/A	On-Off / N/A	Start-Stop / N/A
Charging Line Containment Isolation Valve	30KBA34AA002	Fuel Building	1^N 2^A	N/A	yes	Position / N/A	Open-Close / N/A
Pressurizer Spray Isolation Valve	30KBA35AA001	Reactor Building	4^N 3^A	yes	yes	Position / N/A	Open-Close / N/A

Table 2.2.6-2—CVCS Equipment I&C and Electrical Design (2 Sheets)

Description	Tag Number (1)	Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Charging Line Isolation Valve	30KBA34AA012	Reactor Building	4^N 3^A	yes	yes	Position / N/A	Open-Close / N/A
Seal Injection Containment Isolation Valve	30JEW01AA005	Fuel Building	1^N 2^A	N/A	yes	Position / N/A	Open-Close / N/A
RCP Seal Leak-off Containment Isolation Valve	30JEW50AA001	Reactor Building	4^N 3^A	yes	yes	Position / N/A	Open-Close / N/A
RCP Seal Leak-off Containment Isolation Valve	30JEW50AA002	Fuel Building	1^N 2^A	N/A	yes	Position / N/A	Open-Close / N/A

1) Equipment tag numbers are provided for information only and are not part of the certified design.

2) ^{N} denotes the division the component is normally powered from; ^{A} denotes the division the component is powered from when alternate feed is implemented.

Table 2.2.6-3—Chemical and Volume Control System ITAAC
(7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
2.1	The functional arrangement of the CVCS is as shown on Figure 2.2.6-1.	Inspections of the as-built system as shown on Figure 2.2.6-1 will be conducted	The as-built CVCS conforms with the functional arrangement as shown on Figure 2.2.6-1.
2.2	The location of the CVCS equipment is as listed in Table 2.2.6-1.	An inspection will be performed of the location of the equipment listed in Table 2.2.6-1.	The equipment listed in Table 2.2.6-1 is located as listed in Table 2.2.6-1.
3.1	Deleted.	Deleted.	Deleted.
3.2	Check valves listed in Table 2.2.6-1 will function as listed in Table 2.2.6-1.	Tests will be performed for the operation of the check valves listed in Table 2.2.6-1.	The check valves listed in Table 2.2.6-1 perform the functions listed in Table 2.2.6-1.
3.3	Deleted.	Deleted.	Deleted.
3.4	Components identified as Seismic Category I in Table 2.2.6-1 can withstand seismic design basis loads without a loss of the function listed in Table 2.2.6-1.	a. Type tests, analyses, or a combination of type tests and analyses will be performed on the components identified as Seismic Category I in Table 2.2.6-1 using analytical assumptions, or under conditions, which bound the Seismic Category I design requirements. b. Inspections will be performed of the Seismic Category I components identified in Table 2.2.6-1 to verify that the components, including anchorage, are installed as specified on the construction drawings and deviations have been reconciled to the seismic qualification reports (SQDP, EQDP, or analyses).	a. Seismic qualification reports (SQDP, EQDP, or analyses) exist and conclude that the Seismic Category I components identified in Table 2.2.6-1 can withstand seismic design basis loads without a loss of the function listed in Table 2.2.6-1 including the time required to perform the listed function.. b. Inspection reports exist and conclude that the Seismic Category I components identified in Table 2.2.6-1, including anchorage, are installed as specified on the construction drawings and deviations have been reconciled to the seismic qualification reports (SQDP, EQDP, or analyses).
3.5	Deleted.	Deleted.	Deleted.
3.6	Deleted.	Deleted.	Deleted.

Table 2.2.6-3—Chemical and Volume Control System ITAAC
(7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
3.7	Deleted.	Deleted.	Deleted.
3.8	Deleted.	Deleted.	Deleted.
3.9	Deleted.	Deleted.	Deleted.
3.10	CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 is designed in accordance with ASME Code Section III requirements.	Inspections of the ASME Code Section III Design Reports (NCA-3550) and associated reference documents will be performed. **{{DAC}}**	ASME Code Section III Design Reports (NCA-3550) exist and conclude that CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 complies with ASME Code Section III requirements. **{{DAC}}**
3.11	CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 is installed in accordance with an ASME Code Section III Design Report.	Analyses to reconcile as-built deviations to the ASME Code Design Reports (NCA-3550) will be performed. Piping analyzed using time-history methods will be reconciled to the as-built information.	For CVCS piping shown as ASME Code Section III on Figure 2.2.6-1, ASME Code Data Reports (N-5) exist and conclude that design reconciliation (NCA-3554) has been completed in accordance with the ASME Code Section III for the as-built system. The report(s) document the as-built condition.
3.12	Pressure boundary welds in CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 are in accordance with ASME Code Section III.	Inspections of pressure boundary welds verify that welding is performed in accordance with ASME Code Section III requirements.	ASME Code Section III Data Reports exist and conclude that pressure boundary welding for CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 has been performed in accordance with ASME Code Section III.
3.13	CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 retains pressure boundary integrity at design pressure.	Hydrostatic tests will be performed on the as-built system.	For CVCS piping shown as ASME Code Section III on Figure 2.2.6-1, ASME Code Section III Data Reports exist and conclude that hydrostatic test results comply with ASME Code Section III requirements.

Table 2.2.6-3—Chemical and Volume Control System ITAAC
(7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
3.14	CVCS piping shown as ASME Code Section III on Figure 2.2.6-1 are installed and inspected in accordance with ASME Code Section III requirements.	An inspection of the as-built piping will be performed.	For CVCS piping shown as ASME Code Section III on Figure 2.2.6-1, N–5 Data Reports exist and conclude that installation and inspection are in accordance with ASME Code Section III requirements.
3.15	Components listed in Table 2.2.6-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.	Inspections will be performed for the existence of ASME Code Section III Design Reports.	ASME Code Section III Design Reports (NCA-3550) exist for components listed as ASME Code Section III in Table 2.2.6-1.
3.16	Components listed in Table 2.2.6-1 as ASME Code Section III are fabricated in accordance with ASME Code Section III requirements.	Inspections will be performed to verify that the design report has been revised to reflect as-built deviations from the design if applicable.	For components listed as ASME Code Section III in Table 2.2.6-1, the as-built component satisfies design requirements of ASME Code Section III as demonstrated in the Design Report (NCA-3550).
3.17	Pressure boundary welds on components listed in Table 2.2.6-1 as ASME Code Section III are in accordance with ASME Code Section III requirements.	Inspections of pressure boundary welds will be performed to verify that welding is performed in accordance with ASME Code Section III requirements.	For components listed as ASME Code Section III in Table 2.2.6-1, ASME Code Section III Data Reports (NCA-8000) exist and conclude that pressure boundary welding has been performed in accordance with ASME Code Section III.
3.18	Components listed in Table 2.2.6-1 as ASME Code Section III retain pressure boundary integrity at design pressure.	Hydrostatic tests will be performed on the components.	For components listed as ASME Code Section III in Table 2.2.6-1, ASME Code Section III Data Reports exist and conclude that hydrostatic test results comply with ASME Code Section III requirements.

Table 2.2.6-3—Chemical and Volume Control System ITAAC
(7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
4.1	Displays exist or can be retrieved in the MCR and the RSS as identified in Table 2.2.6-2.	Tests will be performed for the retrievability of the displays in the MCR or the RSS as listed in Table 2.2.6-2.	a. The displays listed in Table 2.2.6-2 as being retrieved in the MCR can be retrieved in the MCR. b. The displays listed in Table 2.2.6-2 as being retrieved in the RSS can be retrieved in the RSS.
4.2	Controls exist in the MCR and the RSS as identified in Table 2.2.6-2.	Tests will be performed for the existence of control signals from the MCR and the RSS to the equipment listed in Table 2.2.6-2.	a. The controls listed in Table 2.2.6-2 as being in the MCR exist in the MCR. b. The controls listed in Table 2.2.6-2 as being in the RSS exist in the RSS.
4.3	Equipment listed as being controlled by a PACS module in Table 2.2.6-2 responds to the state requested by a test signal.	A test will be performed using test signals.	Equipment listed as being controlled by a PACS module in Table 2.2.6-2 responds to the state requested by the signal.

Table 2.2.6-3—Chemical and Volume Control System ITAAC
(7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
4.4	The CVCS has the following interlocks: a. Isolation of the charging pump suction from the volume control tank and normal letdown path during a boron dilution event by closure of valves: 30KBA21AA001, 30KBA21AA009, and 30KBA25AA017 b. Isolation of the charging line by closure of valves 30KBA34AA002, 30KBA34AA012, and 30KBA35AA001 c. Isolation of the letdown line on a Safety Injection actuation signal by closure of valves 30KBA10AA001 and 30KBA10AA002.	Tests will be performed using test signals to verify the interlock.	The following interlocks respond as specified below when activated by a test signal: a. Isolation of the charging pump suction from the volume control tank and normal letdown path by closure of valves: 30KBA21AA001, 30KBA21AA009, and 30KBA25AA017. b. Isolation of the charging line by closure of valves 30KBA34AA002, 30KBA34AA012, and 30KBA35AA001. c. Isolation of the letdown line on a safety injection actuation signal by closure of valves 30KBA10AA001 and 30KBA10AA002.
5.1	The components designated as Class 1E in Table 2.2.6-2 are powered from the Class 1E division as listed in Table 2.2.6-2 in a normal or alternate feed condition.	a. Testing will be performed for components designated as Class 1E in Table 2.2.6-2 by providing a test signal in each normally aligned division. b. Testing will be performed for components designated as Class 1E in Table 2.2.6-2 by providing a test signal in each division with the alternate feed aligned to the divisional pair.	a. The test signal provided in the normally aligned division is present at the respective Class 1E component identified in Table 2.2.6-2. b. The test signal provided in each division with the alternate feed aligned to the divisional pair is present at the respective Class 1E component identified in Table 2.2.6-2.
5.2	Valves listed in Table 2.2.6-2 fail as-is on loss of power.	Testing will be performed for the valves listed in Table 2.2.6-2 to fail as-is on loss of power.	Following loss of power, the valves listed in Table 2.2.6-2 fail as-is.

Table 2.2.6-3—Chemical and Volume Control System ITAAC
(7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
6.1	Components in Table 2.2.6-2, that are designated as harsh environment, will perform the function listed in Table 2.2.6-1 in the environments that exist during and following design basis events.	a. Type tests or type tests and analysis will be performed to demonstrate the ability of the components listed as harsh environment in Table 2.2.6-2 to perform the function listed in Table 2.2.6-1 for the environmental conditions that could occur during and following design basis events.	a. Environmental Qualification Data Packages (EQDP) exist and conclude that the components listed as harsh environment in Table 2.2.6-2 can perform the function listed in Table 2.2.6-1 during and following design basis events including the time required to perform the listed function..
		b. Components listed as harsh environment in Table 2.2.6-2 will be inspected to verify installation in accordance with the construction drawings including the associated wiring, cables and terminations. Deviations to the construction drawings will be reconciled to the EQDP.	b. Inspection reports exists and conclude that the components listed in Table 2.2.6-2 as harsh environment has been installed per the construction drawings and any deviations have been reconciled to the EQDP.
7.1	Deleted.	Deleted.	Deleted.
7.2	Class 1E valves listed in Table 2.2.6-2 perform the function listed in Table 2.2.6-1 under system operating conditions.	Tests and analyses or a combination of tests and analyses will be performed to demonstrate the ability of the valves listed in Table 2.2.6-2 to change position as listed in Table 2.2.6-1 under system operating conditions.	The valve changes position as listed Table 2.2.6-1 under system operating conditions.
7.3	Containment isolation valves listed in Table 2.2.6-1 close within the containment isolation response time following initiation of a containment isolation signal.	Tests will be performed to demonstrate the ability of the containment isolation valves listed in Table 2.2.6-1 to close within the containment isolation response time following initiation of a containment isolation signal.	Containment isolation valves listed in Table 2.2.6-1 close within 60 seconds following initiation of a containment isolation signal.

Table 2.2.6-3—Chemical and Volume Control System ITAAC
(7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
7.4	The system run-out flow does not exceed the design maximum allowable.	A test will be performed.	The CVCS system run-out flow rate is equal to or less than 112.66 lb_m/s total with both CVCS pumps running.
7.5	The CVCS charging pumps listed in Table 2.2.6-1 provide the required seal water flow for operation of the reactor coolant pumps.	Testing will be performed to verify each CVCS charging pump provides the required seal water flow to the reactor coolant pumps.	A CVCS charging pump provides a minimum seal water flow rate of 6.15 gpm to each operating reactor coolant pump.

Next File